US006694004B1

(12) **United States Patent**
Knoerle et al.

(10) **Patent No.: US 6,694,004 B1**
(45) **Date of Patent: Feb. 17, 2004**

(54) **SYSTEM AND METHOD FOR SIMULTANEOUS RING SERVICE WITH CENTRALIZED SUBSCRIPTION DATA**

(75) Inventors: **Joseph Michael Knoerle**, Atlanta, GA (US); **Hong Nguyen**, Atlanta, GA (US); **Zeeman Zhang**, Marietta, GA (US); **Michael Griffiths**, Duluth, GA (US)

(73) Assignee: **Bellsouth Intellectual Property Corporation**, Wilmington, DE (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 333 days.

(21) Appl. No.: **09/749,824**

(22) Filed: **Dec. 28, 2000**

(51) **Int. Cl.**[7] **H04M 3/42**

(52) **U.S. Cl.** **379/211.04**; 379/221.11; 379/221.08

(58) **Field of Search** 379/211.04, 211.02

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,206,901	A *	4/1993	Harlow et al.	379/211.04
5,701,301	A	12/1997	Weisser, Jr.	370/428
5,838,774	A	11/1998	Weisser, Jr.	379/92.02

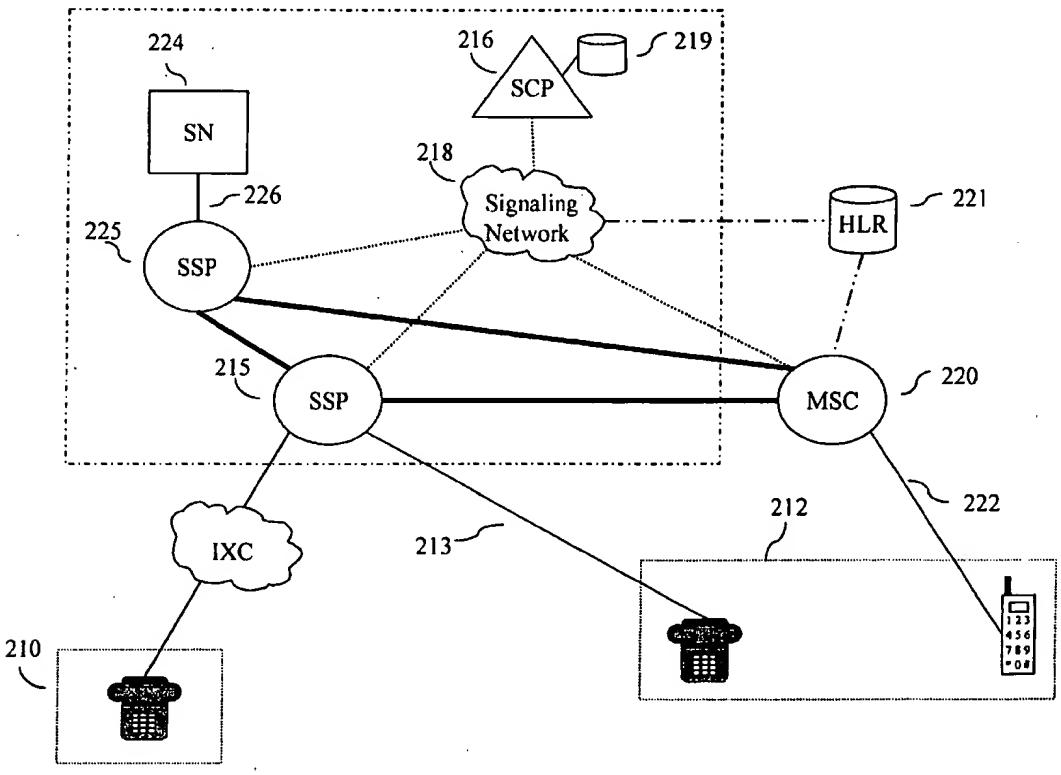
* cited by examiner

Primary Examiner—Harry S. Hong
Assistant Examiner—Karen Le
(74) *Attorney, Agent, or Firm*—Shaw Pittman LLP

(57) **ABSTRACT**

A system and method for providing simultaneous ringing service to a plurality of customer premises equipment. The method and system utilize a centralized database of subscriber information and a service node to make multiple outbound calls from the service node to multiple telephone lines assigned to a subscriber. The subscriber's telephone lines may include one or more wireless lines. Inbound calls to the subscriber's primary wireline are intercepted by the simultaneous ringing service and forwarded to the service node for processing.

23 Claims, 6 Drawing Sheets



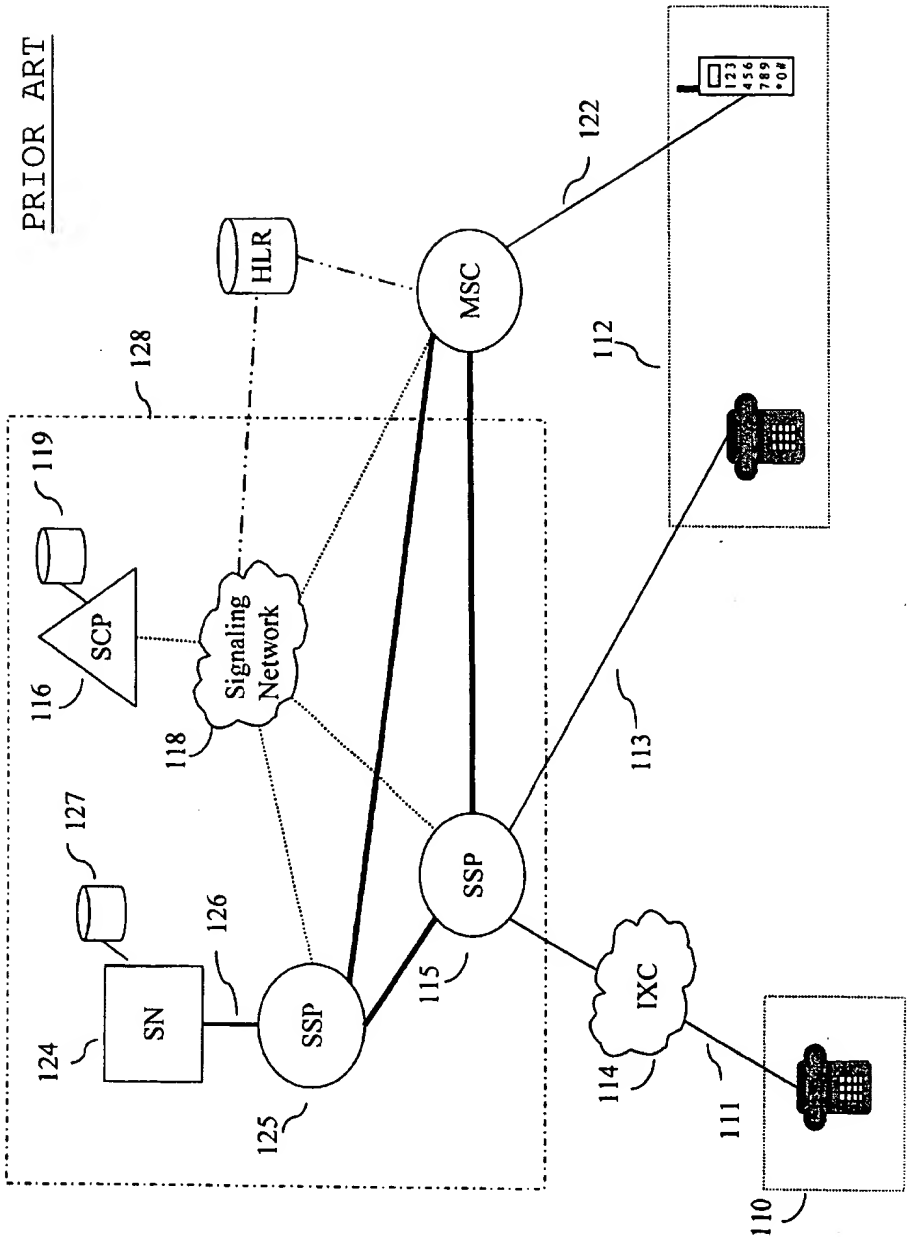

PRIOR ART
HLR
MSC
122
112
128
119
SCP
116
Signaling Network
118
113
127
126
SSP
SN
124
SSP
115
IXC
114
111
125
110

Fig. 1

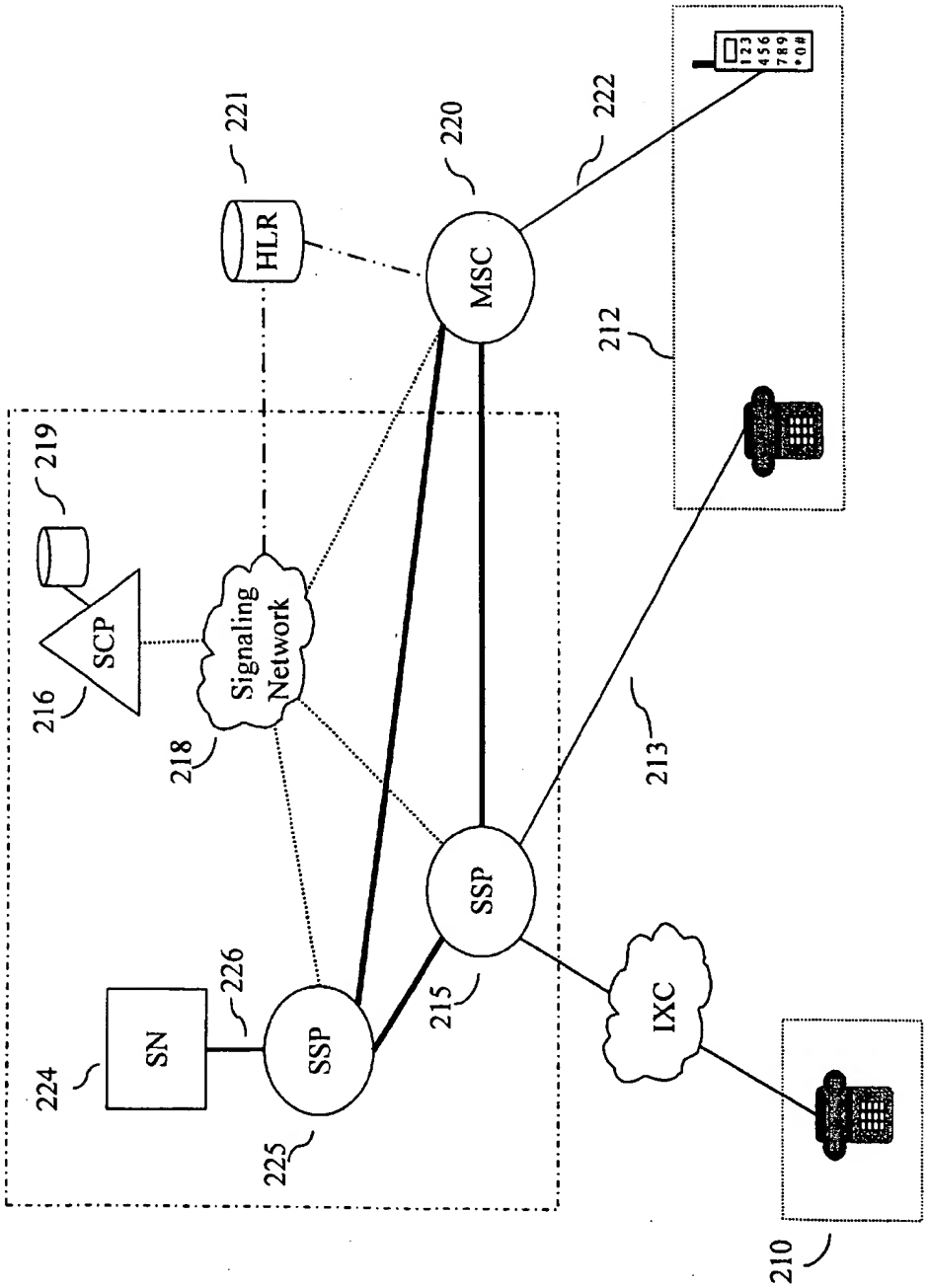

221
220
222
HLR
MSC
212
219
SCP
Signaling Network
216
218
213
SSP
226
SN
SSP
215
IXC
224
225
210

Fig. 2

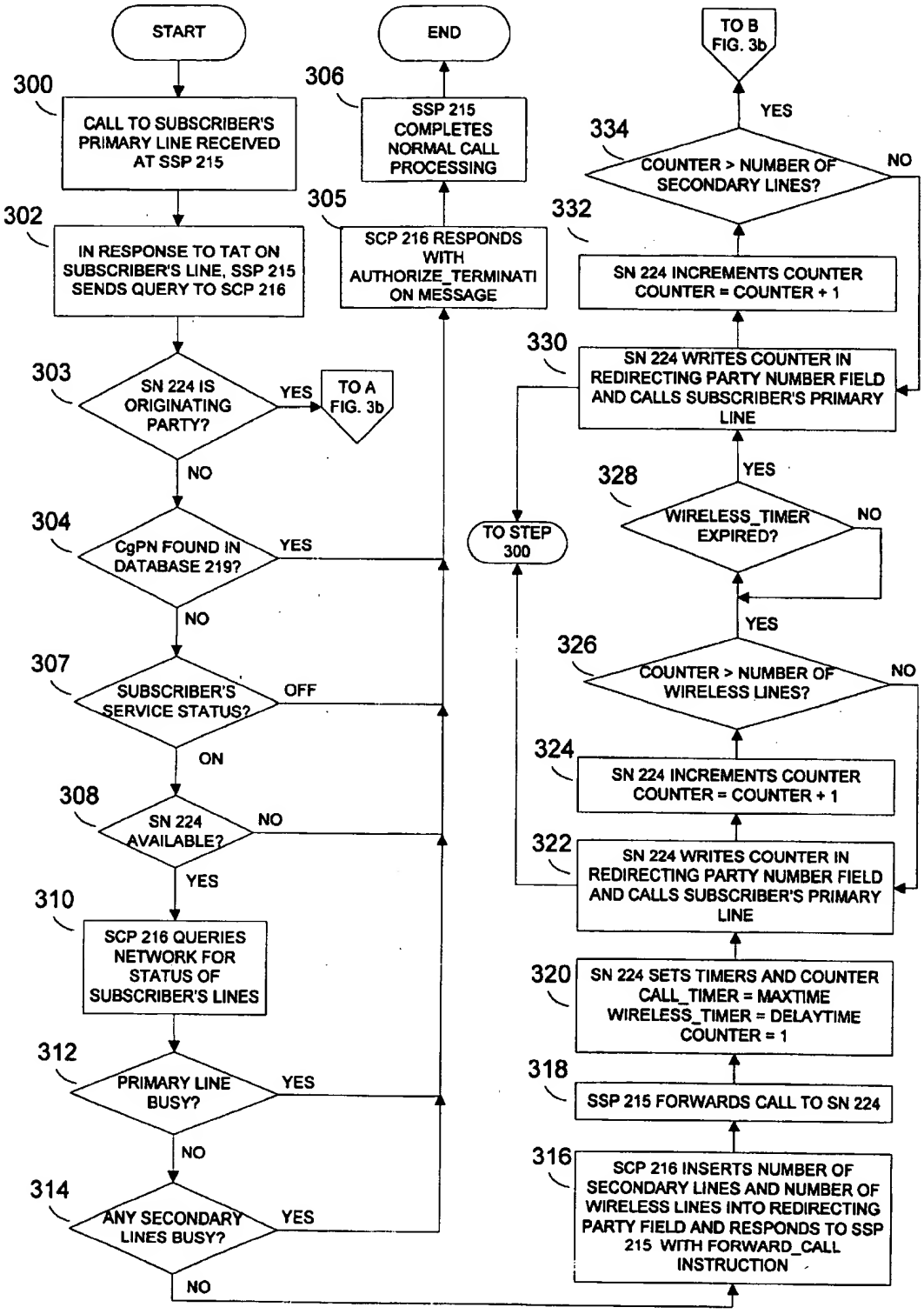

START
300
CALL TO SUBSCRIBER'S PRIMARY LINE RECEIVED AT SSP 215
302
IN RESPONSE TO TAT ON SUBSCRIBER'S LINE, SSP 215 SENDS QUERY TO SCP 216
303
SN 224 IS ORIGINATING PARTY?
YES
TO A FIG. 3b
NO
304
CgPN FOUND IN DATABASE 219?
YES
NO
307
SUBSCRIBER'S SERVICE STATUS?
OFF
ON
308
SN 224 AVAILABLE?
NO
YES
310
SCP 216 QUERIES NETWORK FOR STATUS OF SUBSCRIBER'S LINES
312
PRIMARY LINE BUSY?
YES
NO
314
ANY SECONDARY LINES BUSY?
YES
NO
END
306
SSP 215 COMPLETES NORMAL CALL PROCESSING
305
SCP 216 RESPONDS WITH AUTHORIZE_TERMINATION MESSAGE
TO B FIG. 3b
YES
334
COUNTER > NUMBER OF SECONDARY LINES?
NO
332
SN 224 INCREMENTS COUNTER COUNTER = COUNTER + 1
330
SN 224 WRITES COUNTER IN REDIRECTING PARTY NUMBER FIELD AND CALLS SUBSCRIBER'S PRIMARY LINE
TO STEP 300
YES
328
WIRELESS_TIMER EXPIRED?
NO
YES
326
COUNTER > NUMBER OF WIRELESS LINES?
NO
324
SN 224 INCREMENTS COUNTER COUNTER = COUNTER + 1
322
SN 224 WRITES COUNTER IN REDIRECTING PARTY NUMBER FIELD AND CALLS SUBSCRIBER'S PRIMARY LINE
320
SN 224 SETS TIMERS AND COUNTER CALL_TIMER = MAXTIME WIRELESS_TIMER = DELAYTIME COUNTER = 1
318
SSP 215 FORWARDS CALL TO SN 224
316
SCP 216 INSERTS NUMBER OF SECONDARY LINES AND NUMBER OF WIRELESS LINES INTO REDIRECTING PARTY FIELD AND RESPONDS TO SSP 215 WITH FORWARD_CALL INSTRUCTION

FIG. 3a

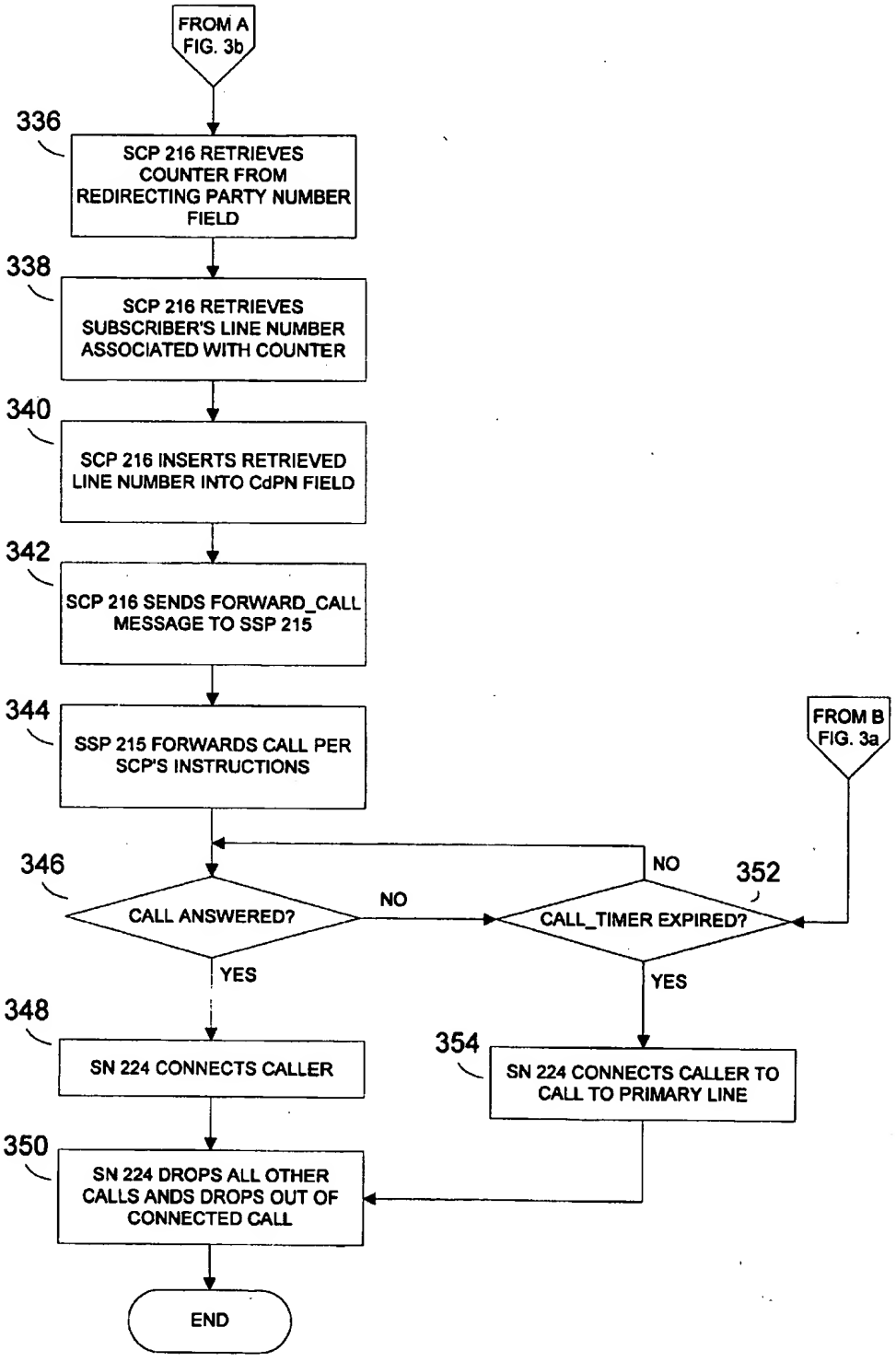

FROM A FIG. 3b
336
SCP 216 RETRIEVES COUNTER FROM REDIRECTING PARTY NUMBER FIELD
338
SCP 216 RETRIEVES SUBSCRIBER'S LINE NUMBER ASSOCIATED WITH COUNTER
340
SCP 216 INSERTS RETRIEVED LINE NUMBER INTO CdPN FIELD
342
SCP 216 SENDS FORWARD_CALL MESSAGE TO SSP 215
344
SSP 215 FORWARDS CALL PER SCP'S INSTRUCTIONS
FROM B FIG. 3a
346
CALL ANSWERED?
NO
352
CALL_TIMER EXPIRED?
NO
YES
YES
348
SN 224 CONNECTS CALLER
354
SN 224 CONNECTS CALLER TO CALL TO PRIMARY LINE
350
SN 224 DROPS ALL OTHER CALLS ANDS DROPS OUT OF CONNECTED CALL
END

FIG. 3b

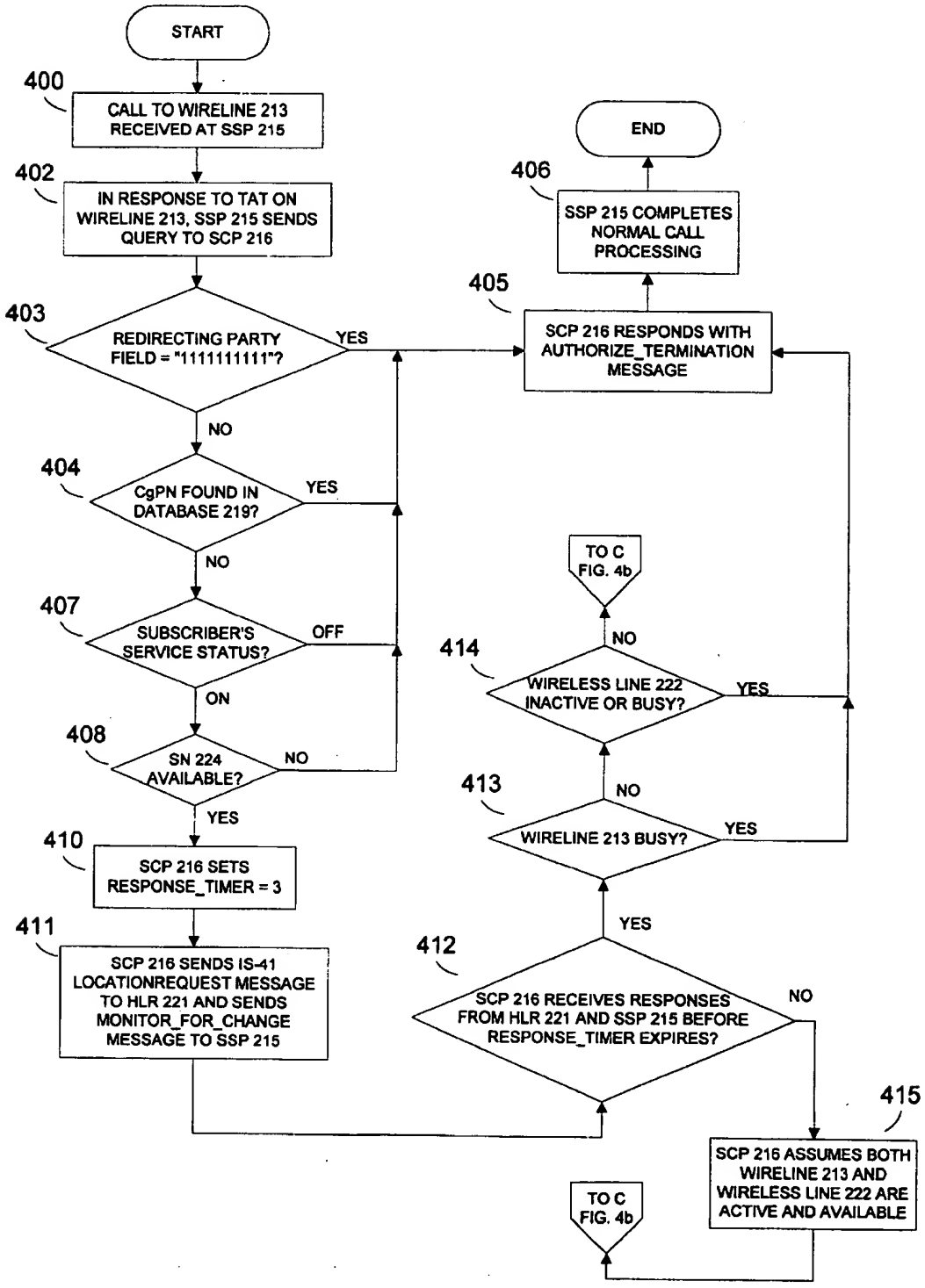

START
400
CALL TO WIRELINE 213 RECEIVED AT SSP 215
402
IN RESPONSE TO TAT ON WIRELINE 213, SSP 215 SENDS QUERY TO SCP 216
403
REDIRECTING PARTY FIELD = "1111111111"?
YES
NO
404
CgPN FOUND IN DATABASE 219?
YES
NO
407
SUBSCRIBER'S SERVICE STATUS?
OFF
ON
408
SN 224 AVAILABLE?
NO
YES
410
SCP 216 SETS RESPONSE_TIMER = 3
411
SCP 216 SENDS IS-41 LOCATIONREQUEST MESSAGE TO HLR 221 AND SENDS MONITOR_FOR_CHANGE MESSAGE TO SSP 215
405
SCP 216 RESPONDS WITH AUTHORIZE_TERMINATION MESSAGE
406
SSP 215 COMPLETES NORMAL CALL PROCESSING
END
TO C FIG. 4b
414
WIRELESS LINE 222 INACTIVE OR BUSY?
NO
YES
413
WIRELINE 213 BUSY?
NO
YES
412
SCP 216 RECEIVES RESPONSES FROM HLR 221 AND SSP 215 BEFORE RESPONSE_TIMER EXPIRES?
YES
NO
415
SCP 216 ASSUMES BOTH WIRELINE 213 AND WIRELESS LINE 222 ARE ACTIVE AND AVAILABLE
TO C FIG. 4b

FIG. 4a

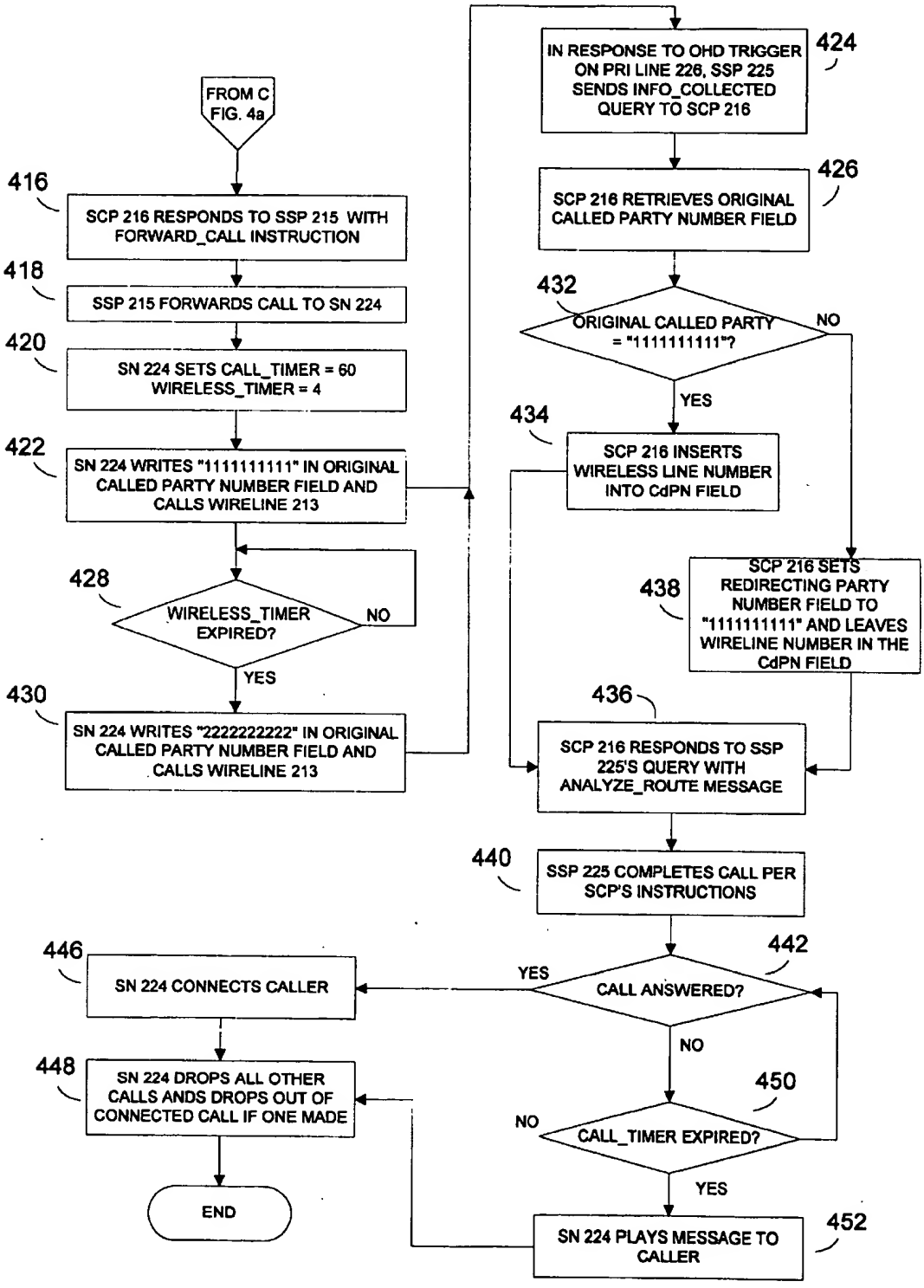

FROM C FIG. 4a
416
SCP 216 RESPONDS TO SSP 215 WITH FORWARD_CALL INSTRUCTION
418
SSP 215 FORWARDS CALL TO SN 224
420
SN 224 SETS CALL_TIMER = 60 WIRELESS_TIMER = 4
422
SN 224 WRITES "1111111111" IN ORIGINAL CALLED PARTY NUMBER FIELD AND CALLS WIRELINE 213
428
WIRELESS_TIMER EXPIRED?
NO
YES
430
SN 224 WRITES "2222222222" IN ORIGINAL CALLED PARTY NUMBER FIELD AND CALLS WIRELINE 213
424
IN RESPONSE TO OHD TRIGGER ON PRI LINE 226, SSP 225 SENDS INFO_COLLECTED QUERY TO SCP 216
426
SCP 216 RETRIEVES ORIGINAL CALLED PARTY NUMBER FIELD
432
ORIGINAL CALLED PARTY = "1111111111"?
NO
YES
434
SCP 216 INSERTS WIRELESS LINE NUMBER INTO CdPN FIELD
438
SCP 216 SETS REDIRECTING PARTY NUMBER FIELD TO "1111111111" AND LEAVES WIRELINE NUMBER IN THE CdPN FIELD
436
SCP 216 RESPONDS TO SSP 225'S QUERY WITH ANALYZE_ROUTE MESSAGE
440
SSP 225 COMPLETES CALL PER SCP'S INSTRUCTIONS
442
CALL ANSWERED?
YES
NO
446
SN 224 CONNECTS CALLER
448
SN 224 DROPS ALL OTHER CALLS ANDS DROPS OUT OF CONNECTED CALL IF ONE MADE
450
CALL_TIMER EXPIRED?
NO
YES
452
SN 224 PLAYS MESSAGE TO CALLER
END

FIG. 4b

SYSTEM AND METHOD FOR SIMULTANEOUS RING SERVICE WITH CENTRALIZED SUBSCRIPTION DATA

BACKGROUND

1. Field of the Invention

The present invention relates generally to telecommunications systems and services provided in an advanced intelligent network ("AIN") environment and more specifically to telecommunication systems for simultaneously ringing multiple subscriber lines when a single call is placed to a subscriber's primary line.

2. Background of the Invention

Multiple communications systems have become ubiquitous in today's society. It is not uncommon for individuals, referred to herein as "subscribers," to have more than one telephone system including both wireline telephones and wireless telephones. Subscribers' wireline telephones may or may not be co-located in the same building and the wireless telephones are, by design, highly mobile. This situation has resulted in a need for subscribers to maintain and distribute multiple telephone numbers which may be used to establish communication.

When a caller tries to reach a subscriber, the caller must dial the subscriber's first telephone number and wait to see if anyone answers the call. If the call goes unanswered, the caller must try the next number and again wait for an answer. This process must be repeated until one of the calls is answered or the caller has tried all of the subscriber's numbers without success. This situation can be frustrating for a caller because multiple telephone calls may have to be tried before successfully reaching the subscriber. Similarly, subscribers can be frustrated because the end result may be a missed call. Simultaneous ring services have been offered to solve this problem for subscribers having multiple telephone numbers.

In a simultaneous ring service, when a call is made to a subscriber's wireline ("primary line") telephone number, the service provides a ringing tone on the primary line and on designated secondary lines. Such a service connects the caller to whichever telephone line is answered first. As known in the art, such simultaneous ring services may be extended to ring many different lines, wired or wireless, at the same time or to ring a series of lines in rapid succession. For simplicity, the description of conventional simultaneous ring services and the system and service of the present invention will be generally directed to simultaneous ringing of only two telephone lines. One of ordinary skill in the art will recognize how such services can be adapted to ring more than two lines simultaneously.

Although such simultaneous ring services have solved the subscribers' problems, the implementation used in conventional services has resulted in further problems for the telephone service providers ("telcos"). Conventional simultaneous ring services are implemented using a service node ("SN") comprising the telco's customer subscription data as described in more detail below.

Conventional Simultaneous Ring Service

Caller **110** in FIG. **1** is the person attempting to reach subscriber **112**, a customer of telco **128**. Caller **110** has telephone line **111**. As known in the art, caller **110** could also be a customer of telco **128**, or, caller **110** could be a foreign customer connecting through inter-exchange carrier ("IXC") **114** as shown in FIG. **1**. In the schematic diagram shown in FIG. **1**, when caller **110** places a call to subscriber **112**'s primary line (i.e., wireline **113**) the call hits a termination attempt trigger ("TAT") on service switching point ("SSP" or "switch") **115**. In response to this trigger, SSP **115** sends a query to service control point ("SCP") **116** via signaling network **118**. As known in the art, signaling network **118** is a packet switched network consisting of various network components, including, e.g., signaling transfer points ("STPs"), SSPs, SCPs and the like. Common Channel Signaling System Number 7 ("SS7") is a network protocol commonly used in signaling networks in North America, although other protocols may be implemented elsewhere or in the future. For the present invention, the specific signaling network protocol implemented is not important.

As known in the art, SCP **116** uses data stored in database **119** to formulate an appropriate answer to AIN queries it receives. Database **119** typically stores a plurality of records associated with each subscriber of the various services provided by the particular SCP. In the case of a conventional simultaneous ring service, database **119** includes the telephone numbers for the subscriber's primary line and designated secondary lines, including wireless line **122**. The database further includes information regarding the type of line used for each secondary line (i.e., whether the lines are wirelines or wireless lines). In response to the query from SSP **115**, SCP **116** first checks database **119** to see if the calling party number corresponds to one of the subscriber's designated secondary lines. If a match is made, SCP **116** instructs SSP **115** to continue with normal call processing, i.e., wireline **113** rings if it is available or caller **110** is provided a busy signal if wireline **113** is busy. If a match is not made, SCP **116** directs SSP **115** to forward the call to SN **124** for further call processing. As known in the art, SN **124** could be served by the same switch as the subscriber, or could be served by a different switch. In FIG. **1**, SN **124** is served by a different switch, SSP **125**, via PRI trunk **126**.

As shown in FIG. **1**, in conventional simultaneous ring services SN **124** uses database **127** to store a plurality of records associated with subscriber of the service. Just as with database **119** (on SCP **116**) database **127** (on SN **124**) stores telephone numbers for the subscriber's primary and secondary lines and type information for the secondary lines. As described above, SSP **115** forwards the call the SN **124** for further call processing. SN **124** uses the subscriber's primary line telephone number, contained in the redirecting party number field of the call setup message, to identify the subscriber being called. SN **124** looks up the subscriber's secondary numbers in database **127** and initiates calls to each secondary number as well as to the primary number. SN **124** prioritizes and spaces these calls as necessary if any of the secondary lines are wireless lines. As soon as one of these calls is answered, SN **124** connects caller **110** to the answered line and ends the unanswered calls. As discussed above, this conventional simultaneous ring service provides the functionality needed from the subscriber's and the caller's point of view. However, the conventional implementation described above is not efficient for the telco providing the service.

As known in the art service nodes as very expensive systems and are generally for specific applications. If the load on a particular service node is heavy, multiple service nodes may be required to accommodate an application. Because conventional implementation requires subscription data to be stored on a service node, telco **128** must maintain multiple databases on multiple network nodes. Moreover, the information in these databases is duplicative of the

information already needed to be stored in the service control point as described above. A need therefore exists for a more efficient system and method for providing simultaneous ring services for subscribers.

SUMMARY OF THE INVENTION

The present invention provides a system and method for providing simultaneous ringing on multiple subscriber telephone lines using a centralized database for storing the information related to the subscriber's lines. The database is stored on a centralized AIN node, usually a service control point, and it includes the telephone numbers for a subscriber's primary line and one or more secondary lines. When a caller places a call to the subscriber's primary line, a trigger is encountered at the switch serving the subscriber's primary line. In response to the trigger, the subscriber's switch queries the service control point for call processing instructions. In response to this query, the service control point instructs the subscriber's switch to forward the call to a service node. In one embodiment, the service control inserts a code indicating the quantity of wireless lines and the total quantity of secondary lines designated by the subscriber. When the service node receives the forwarded call, it initiates a series of outbound calls to the subscriber's primary and secondary lines as described below.

Because the service node in the present invention does not have any local subscription data, it relies on the service control point to provide the information from its centralized database. To accomplish this, the service node places a call to the subscriber's primary line number, which it retrieves from the information provided within the original forwarded call. In placing this call, the service node inserts a special identification code into the redirecting party number field of the call setup message. This identification code is used to indicate which of the subscriber's designated telephone number is being requested, i.e., whether the first, second, third, etc. telephone number is needed. In one embodiment of the present invention, the switch serving the service node is provisioned with an appropriate trigger that temporarily suspends this call while the switch queries the service control point for call processing instructions. In a second embodiment of the present invention, the trigger on the subscriber's line is used to initiate the query.

The service control point uses the subscriber's primary telephone number (found in the called party number field) and the identification code (found in the redirecting party number field) to retrieve the corresponding secondary telephone number from its database. In one embodiment, the service control point provides telephone numbers corresponding to wireless secondary lines prior to providing wireline numbers. In this manner, the service node spaces the calls out to ensure proper timing for the calls as described in more detail below.

The service control point inserts the retrieved secondary telephone number into the called party number field and instructs the switch to continue call processing using the telephone number provided. The service node repeats these steps for each telephone number in the subscriber's designated list of lines to ring via this service. If one of the called lines is answered, the service node drops the other calls and stops initiating new calls. The caller is then connected to the answered call. If none of the called lines are answered, the service node drops all of the calls. In one embodiment of the present invention, the service node provides an appropriate announcement to the caller.

In one embodiment of the present invention, the simultaneous ringing service performs many additional functions such as checking the status of each line prior to placing the simultaneous calls, or checking to see if the calling party number is one of the subscriber's designated lines. Further, the service can provide an administration system that allows subscribers to change the status of their subscription and to add or delete lines from the database. Finally, in one embodiment of the present invention, a heartbeat call from the service node to the service control point is provided for tracking the availability of the service node for processing simultaneous ring services.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic diagram showing a prior art system for providing simultaneous ringing service.

FIG. **2** is a schematic diagram showing a general system architecture used in an embodiment of the present invention.

FIGS. **3***a* and **3***b* are flow charts showing the call flow for a first embodiment of the present invention.

FIGS. **4***a* and **4***b* are flow charts showing the call flow for a second embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The present invention is best described by providing a detailed description of the call flow in a first embodiment of the present invention. The following description also provides call flows and descriptions for alternative embodiments as noted. FIG. **2** shows the AIN architecture used in the first and alternative embodiments of the present invention and referenced in the call flow descriptions below. An administration system allowing the subscriber to manage his or her simultaneous ringing service is described. Finally, an embodiment for including status messages sent between the SN and the SCP is described.

Call Flow

The call flow used in the first embodiment of the present invention is detailed in FIGS. **3***a* and **3***b*. Caller **210** initiates the simultaneous ring service by dialing the telephone number for subscriber **212**'s primary line, wireline **213**. In step **300**, the call is received by SSP **215**. In step **302**, a TAT on wireline **213** at SSP **215** causes SSP **215** to send an AIN query message to SCP **216**. As described above, query and response messages are sent between AIN nodes via signaling network **218**. In response to the query, SCP **216** provides call processing instructions carrying out the simultaneous ring service as described below.

In step **303**, SCP **216** checks to see if the call originated at the service node. In one embodiment, SCP **216** accomplishes this step by checking the originating number field for the call. If the originating number corresponds to SN **224**, then SCP **216** recognizes that this call is already being handled by the simultaneous ring service. In another embodiment, SCP **216** checks the redirecting party number field to see if a service node has entered any special codes in the field. If SCP **216** determines that the call originated from a service node, the call flow continues at point A in FIG. **3***b*, described in later sections, below. If the originating party number is not associated with SN **224** the call flow moves on to step **304**. In step **304**, SCP **216** checks the calling party number ("CgPN") field in the query message to determine whether or not the caller is calling from one of the subscriber's designated numbers. SCP **216** looks up the called party number ("CdPN"), i.e., the subscriber's primary number in database **219** to see if the CgPN is associated with

it. If the CgPN is found in database **219**, there is no need to ring the wireless number since the subscriber is using one of the secondary lines to call home and the call flow moves on to step **305** where SCP **216** provides an Authorize_Termination response to SSP **215**. In step **306**, SSP **215** completes normal call process, i.e., caller **210** receives a ringing tone, a busy tone, or other normal call termination messages.

If the CgPN was not found in database **219**, the call flow moves on to step **307** where SCP **216** checks the current status of the subscriber's simultaneous ring service. If the subscriber's service is turned off, the call flow moves on to step **305** and SCP **216** sends an Authorize_Termination response and normal call processing continues as described above. If the subscriber's simultaneous ring service is on, the call flow moves on to step **308** where SCP **216** checks to see if SN **224** is available. If SN **224** is not available, the simultaneous ring service will not be provided and the call flow moves on to step **305** as described above.

In step **310** SCP **216** queries the network to determine the status of subscriber **212**'s telephone lines. If, in step **312**, the subscriber's primary line, i.e., wireline **213**, is busy, there is no need for simultaneous ringing because the subscriber is known to be at that location. In this case, the call flow moves on to step **305** for normal call processing as described above. Similarly, if, in step **314**, any of the subscriber's secondary lines are busy there is no need for simultaneous ringing so the call flow moves on to step **305** for normal call processing. Otherwise, if the subscribers primary line and all of the secondary lines are available the call flow moves on to step **316**.

In step **316** SCP **216** responds to the query with a Forward_Call message instructing SSP **215** to route the call to SN **224**. As known in the art, the redirecting party number field in the Forward_Call message is fifteen characters long and would contain the subscriber's primary number (i.e., the original CgPN) with leading zeros or blanks to fill the first five characters. In step **316**, SCP **216** modifies the redirecting party number by appending a code to indicate the quantity of wireless lines and total quantity of secondary lines (including the subscriber's primary line). In the first embodiment of the present invention, the code is appended to the beginning of redirecting party number field of the Forward_Call response message. For example, if the subscriber has designated two different wireless lines and two other wirelines to receive simultaneous ringing, SCP **216** appends a code such as "23" to the redirecting party number field. If, e.g., the subscriber's primary line number is "2122223333" the redirecting party number field would be "230002122223333." In step **318**, SSP **215** follows SCP **216**'s instructions and forwards the call to SN **224** with the redirecting party number field as modified by SCP **216**.

In step **320**, SN **224** receives the call and sets appropriate timers and a call counter. The timers include a Call_Timer and a Wireless_Timer. The Call_Timer is set to the maximum time ("MaxTime") allowed for the simultaneous ring service to operate. If, as described below, the Call_Timer expires before any of the secondary lines are answered, caller **210**'s call is connected to a call to the subscriber's primary line. In the preferred embodiment, MaxTime is 60 seconds. The Wireless_Timer is used to compensate for delays ("DelayTime") inherent in establishing a call to a wireless line. SN **224** places calls to each of the wireless lines designated by the subscriber and waits for the Wireless_Timer to expire before placing calls to the wirelines. In the first embodiment, DelayTime is four seconds. The call counter ("Counter") can be used to keep track of how many calls SN **224** has placed. Counter is initialized to "1" in step **318**. After step **320**, SN **224** initiates a series of telephone calls to the subscriber's primary and secondary lines as described below.

In step **322** SN **224** initiates a call to subscriber **212**'s primary line (wireline **213**) and writes the value of Counter in the redirecting party number field of the call setup message. For example, if Counter has a value of "1" SN **224** writes "1111111111" in the redirecting party number field. This code will be used by SCP **216** in later steps to retrieve the subscriber's first telephone number from database **219**. Similarly, if Counter has a value of "4" SN **224** writes "4444444444" in the redirecting party number field and SCP **216** will retrieve the fourth telephone number from the database. Because this call is place to the subscriber's primary line, the call flow branches back to step **300** as indicated in FIG. **3***a*. The TAT on wireline **213** at SSP **215** is again encountered in step **300**, and SSP **215** sends another query to SCP **216** requesting call processing instructions in step **302**. This time, however, in step **303**, the originating party number is that of SN **224** so the call flow moves on to point A in FIG. **3***b*. At the same time as this branch of the call flow is being executed, SN **224** continues on to step **324** where it increments Counter by one.

In step **326** SN **224** compares Counter with the quantity of wireless lines associated with subscriber **212**. Recall that SN **224** previously received this information from SCP **216** in step **316**. If Counter is not greater than the quantity wireless lines then SN **224** returns to step **322** and places another call to the subscriber's primary line (wireline **213**) as described above. This time, the current (i.e., as incremented in step **324**) value of Counter is written in the redirecting party number field so that the next telephone number will be retrieved by SCP **216** in later steps. If, in step **326**, Counter is greater than the quantity of wireless lines, the call flow moves on to step **328**. Step **328** represents a waiting state. That is, even if SN **224** has already placed calls to each wireless line, it waits until Wireless_Timer has expired (i.e., DelayTime has passed) before moving on to step **330**.

In step **330** SN **224** places another call to the subscriber's primary line (wireline **213**) as described above. As described above, the current value of Counter is written in the redirecting party number field so that the next telephone number will be retrieved by SCP **216** in later steps. Again, call flow branches after SN **224** places the outbound call to the subscriber's primary line, and the process branches to step **300**. Meanwhile, in step **332** SN **224** increments Counter again then moves on to step **334**. In step **334**, if Counter is greater than the total quantity of lines designated by the subscriber for simultaneous ring service, no more calls need to be placed and the process moves on to point B in FIG. **3***b*. If Counter is not greater than the total quantity of designated lines, SN **224** returns to step **330** to place another call to the subscriber's primary line as described above.

FIG. **3***b* picks up the call flow for calls placed from SN **224** to the subscriber's primary number. As described above in connection with steps **300–303**, all such calls encounter the TAT on the subscriber's line at SSP **215** and in response to the TAT, SCP **216** recognizes that the call originated from SN **224**. In step **336**, SCP **216** retrieves the value of Counter from the redirecting party number field of the query message from SSP **215**. In step **338**, SCP **216** retrieves the appropriate telephone number to be called by looking up the subscriber's primary line number (obtained from the CgPN field) and retrieving the Nth designated number, where N corresponds to Counter.

In step **340** SCP **216** writes the retrieved telephone number in the CdPN field and responds to the query by instructing SSP **215** to forward the call to the new CdPN in step **342**. In step **344**, SCP **215** forwards the call to the designated telephone according to SCP **216**'s instructions. If the call is answered in step **346** SN **224** connects the caller in step **348**. In step **350** SN **224** drops any other calls that are in progress and drops out of call between caller **210** and the answered line. If in step **346** the call has not been answered, the call flow moves on to step **352**. In step **352**, Call_Timer is checked to see if MaxTime has passed. If MaxTime has passed, SN **224** moves on to step **354** and connects the caller to the subscriber's primary line. Then, in step **350**, SN **224** drops any other calls in progress and drops out of the connected call as described above. By connecting the caller to the primary line SN **224** ensures that caller **210** receives some form of call termination (i.e., a busy signal, ringing tone, etc.). In a second embodiment of the present invention, SN **224** could provide caller **210** with an announcement indicating that caller **212** is not available to take the call and forwards the call to a voice mail system. If, in step **352**, Call_Timer has not expired then the call flow returns to step **346** to see if the call has been answered yet as described above.

Steps **336** and beyond are performed each time SN **224** places another outbound call to the subscriber's primary line. That is, each time SCP **216** receives a query and the originating node was SN **224**, it looks up the next telephone number in subscriber **212**'s designated list of simultaneous ringing lines. The calls are ongoing concurrently, that is, SN **224** places multiple calls at the same time or in very rapid succession so that the calls to each designated number being attempted at roughly the same time. If any one of the calls is answered (i.e., in step **346**) the call flow moves on to steps **348** and **350** for final call processing as described above. Similarly, if none of the calls are answered before the maximum call timer expires, the call flow moves on to steps **354** and **350** for final call processing.

In an alternative embodiment of the present invention, in step **320**, SN **224** can provide an announcement to caller **210** such as "Please hold while your is being processed." The announcement could also provide other informative messages, e.g., advertising, or could play music while the simultaneous ring services tries to locate the subscriber. In this embodiment, step **352** can be modified so that SN **224** plays a message to the caller explaining that the subscriber could not be reached. The caller could also be provided an option to connect to the subscriber's primary line in which case step **352** as previously described is performed.

FIGS. **4***a* and **4***b* show the call flow associated with a second embodiment of the present invention. This embodiment is also used to provide a more specific example of the messages that may be passed between the various AIN nodes when providing simultaneous ring services according to the present invention. In this example, the simultaneous ring service is configured to provide simultaneous ringing only to the subscriber's primary line and one secondary line. One of ordinary skill in the art can adapt the steps described above in connection with the first embodiment if more than two lines will receive simultaneous ringing.

In steps **400** and **402** caller **210**'s call to wireline **213** encounters the TAT on the line and causes SSP **215** to send a Termination_Attempt query message to SCP **216**. In steps **403** through **408**, SCP **216** checks the CgPN, the subscriber's simultaneous ring subscription status, and the status of SN **224**, as described previously in corresponding steps **303** through **308**. Accordingly, if the call originated from SN **224** (i.e., for example "1111111111" is in the redirecting party number field in step **403**) or the CgPN is in database **219** (step **404**) or the subscription is turned off (step **407**) or SN **224** is unavailable (step **408**), SCP **216** responds to SSP **215** by sending an Authorize_Termination message (step **405**) and normal call processing proceeds in step **406**. Otherwise, in step **410** SCP **216** sets Response_Timer to three seconds to insure call processing continues even if it fails to determine the status of the subscriber's wireline and wireless line in steps **411** and **412**.

In step **411**, SCP **216** checks the status of the subscriber's primary and secondary lines by sending queries to network nodes responsible for each line. That is, SCP **216** sends a LocationRequest query message to HLR **221** and a Monitor_For_Change instruction to SSP **215**. As known in the art, LocationRequest query message uses the IS-41 protocol. In response to this query, HLR **221** should send SCP **216** a LocationRequest Return Result message indicating whether wireless line **222** is active, busy or inactive. Similarly, SSP **215** should return a Status_Reported message indicating whether wireline **213** is active or busy. In step **412**, SCP checks to see if the expected responses have been received before the Response_Timer expires. If so, call processing continues to step **413** where, if SSP **215** reports that wireline **213** is busy, SCP **216** determines that no simultaneous ringing is necessary. In this case, SCP **216** moves on to steps **405** and **406** and normal call processing is provided. Similarly, if wireless line **222** is either busy or inactive (as reported by HLR **221**) SCP **216** determines that no simultaneous ringing is necessary and sends an Authorize_Termination message to SSP **215** (steps **405** and **406**). Call processing continues after step **414** at point C in FIG. **4***b*, as described below.

If, in step **412**, the Response_Timer has expired before receiving responses from either of HLR **221** or SSP **215**,SCP **216** moves on to step **415**. In step **415**, SCP **216** assumes that both wireline **213** and wireless line **222** are available (i.e., active and not busy). Call processing continues after this step at point C in FIG. **4***b*.

Continuing on in step **416**, SCP **216** responds to SSP **215** by sending a Forward_Call message to direct the call to SN **224**. In this embodiment, the redirecting party number field is simply the subscriber's primary line number, i.e., the number originally dialed by caller **210**. In step **418**, SSP **215** complies with the service control point's instructions and forwards the call to SN **224**. In step **420**, SN **224** answers the call an sets the Call_Timer to 60 seconds and Wireless_Timer to four seconds. Alternatively, when SN **224** answers the call, it may play an announcement to caller **210** informing the caller that the simultaneous ring service is attempting to reach the subscriber before setting the timers as described. In an another variation of this embodiment, the caller may be offered an opportunity to skip the simultaneous ring service and the service node acts accordingly.

Once the timers have been set in step **420**, SN **224** places an outbound call in step **422** to wireline **213** using the number retrieved from the redirecting party number field of the inbound call. Moreover, in step **422**, SN **224** inserts the code "1111111111" into the original called party number field of the outbound call to identify this call as a request for the subscriber's wireless line telephone. After the Wireless_Timer has expired (step **428**) SN **224** places a second outbound call to wireline **213** in step **430**. This second call has the code "2222222222" in the original called party number field to identify it as a request to connect to the subscriber's wireline **213**. Both of these outbound calls encounter a trigger on SSP **225**, the switch service SN **224** as described below.

In this embodiment PRI trunk group **226** is provisioned with a Channel Setup PRI/Off-Hook Delayed ("OHD") trigger on SSP **225**. Accordingly, when SN **224** originates any calls on the B channels of the PRI interface, the OHD trigger is encountered. In step **424**, in response to the OHD trigger SSP **225** sends an Info_Collected query to SCP **216** for call processing instructions. In response to this query, SCP **216** returns an Analyze_Route response in step **436**. Prior to sending this response, SCP **216** determines the appropriate calling parameters by examining the information provided by SN **224** in the call query message, as described below.

In this embodiment, the original called party number field indicates which call is being placed by SN **224**. In step **426**, SCP **216** retrieves the original called party number and determines which telephone number is required from database **219** in step **432**. In this example, when the first outbound call from SN **224** encountered the trigger, the original called party number field contains "1111111111" and SCP **216** moves on to step **434**. In step **434**, SCP **216** inserts the telephone number for subscriber **212**'s wireless line **222** as indicated in database **219**. The second outbound call from SN **224** does not contain "1111111111" in the original called party field (in this example the field contains "2222222222") so SCP **216** moves on to step **438**. In step **438** SCP **216** sets the redirecting party number field to a code, such as e.g., "1111111111" and leaves the wireline telephone number in the called party field. This code in the redirecting party number field is used in step **403** to determine the appropriate response to the TAT on wireline **213** as described above.

Using the parameters as set in either steps **434** or **436**, SCP **216** moves on the step **436** and sends the Analyze_Route response to SSP **225**. In step **440**, SSP **225** completes each call according to the instructions provided in SCP **216**'s response message. In step **442**, SN **224** determines whether or not either telephone call has been answered. If so, SN **224** connects caller **210** to the answered call in step **446** and drops the unanswered in step **448**. If neither call has been answered (in step **442**) SN **224** checks to see if Call_Timer has expired. If not, SN **224** returns to step **442** and checks to see if one of the calls has been answered. Otherwise, SN **224** plays a message to caller **210** in step **452**. The message could inform the caller that the subscriber could not be located or was not available to take the call. SN **224** then drops all of the calls is step **448** and the service is completed.

Using the Channel Setup PRI/OHD trigger in this embodiment allows SCP **216** to supply the wireless number to route the call and at the same time allows the caller's caller ID information to be displayed to the end-user. SN **224** provides the caller ID if it is "available" or marks the caller ID as "private/restricted" or "unavailable," as appropriate.

Service Activation/Deactivation Menu

In one embodiment, the subscriber can turn the simultaneous ring service on and off by dialing an administration number on a central office switch (not shown in FIG. **2**). A TAT trigger is assigned to the administration number on that switch. When the subscriber's call reaches the switch, the TAT is encountered causing the switch to launch a query to SCP **216**. SCP **216** looks up the calling party ID in database **219** to retrieve subscriber **212**'s information. If the calling party ID information is not delivered (e.g., the line is marked private), SCP **216** issues a Send_to_Resource message to the switch directing the switch to play an announcement and collect the end-user subscriber ID and personal identification number ("PIN"). The subscriber ID is the number for wireline **213** or some other unique number associated with subscriber **212**.

An interactive menu is provided by the switch under SCP **216**'s direction via Send_To_Resource and Resource_Clear messages. The end-user may hear an announcement stating the status of the service such as "Your Simultaneous Ring service is now on." The menu allows the end-user to enable or disable the service as desired. In an alternate embodiment, a service node may be used to interact with the subscriber and the SCP instead of a switch. In this embodiment, the service node can be selected by the SCP in response to a TAT on the administration number at the switch. Thus, the programming logic for requesting information from the subscriber can be customized and placed on multiple service node to accommodate systems workloads.

Heart Beat Call

In one embodiment, SN **224** regularly communicates its status to SCP **216**. SN **224** periodically calls a telephone number set up for this purpose. The periodic call is known as a "heartbeat" call because as long as SCP **216** receives a status message, it assumes that SN **224** is "alive," i.e., available to provide the simultaneous ring service. The interval between heart beat calls can be set as appropriate given the amount of congestion or other factors affecting performance of the SN. In one embodiment, the timer is set to 30 seconds. When the timer expires, SN **224** makes a PRI call by dialing the pre-defined heart beat number. SN **224** inserts various codes into the redirecting party number field to convey its status information to SCP **216**. The status information conveyed includes the time interval indicating when SCP **216** should receive the next heartbeat call.

Because SN **224** uses the PRI lines, the PRI Channel Setup/OHD trigger is encountered at SSP **225**. SSP **225** sends a query to SCP **216** which recognizes the call as a heartbeat call, based on the called party number field. SCP **216** retrieves the status information and updates SN **224**'s status in database **219** and returns an appropriate response message to SSP **225**. In one embodiment, the response message is a Send_to_Resource message instructing SSP **225** to send a Release message to SN **224**. When SN **224** receives this message, it resets the timer for the next heartbeat call and ends the call. Moreover, SCP **216** coordinates with its mated SCP (not shown in FIG. **2**) via an X.25 interface. In this manner, either SCP can serve the simultaneous ring service without interruption.

The foregoing disclosure of embodiments of the present invention has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Many variations and modifications of the embodiments described herein will be obvious to one of ordinary skill in the art in light of the above disclosure. The scope of the invention is to be defined only by the claims appended hereto, and by their equivalents.

What we claim is:

1. A method for providing simultaneous ringing on a plurality of telephone lines using a centralized subscription database, said method comprising:

(a) populating the centralized subscription database with a plurality of telephone numbers associated with the plurality of telephone lines, wherein one of the plurality of telephone numbers is a primary telephone number;

(b) forwarding a first call to the primary telephone number from a first switch to a service node;

(c) placing a second call to the primary telephone number from the service node, wherein the second call comprises a counter in a first field;

(d) inserting a calling party number selected from the centralized subscription database in response to the second call;

(e) completing the second call from the service node to the selected calling party number;

(f) incrementing the counter;

(g) connecting the first call to the second call if said second call is answered; and

(h) repeating steps (c) through (g) for each telephone number in the centralized database.

2. The method of claim 1, further comprising the step of checking the status of each of the plurality of telephone lines.

3. The method of claim 1, wherein the first field is a redirecting party number field.

4. The method of claim 1, wherein the centralized subscription database is populated on a service control point.

5. The method of claim 4, further comprising the step of provisioning a trigger on a second switch wherein said trigger is provisioned for a line serving the service node; and wherein step (d) further comprises sending a query from the second switch to the service control point and selecting the calling party number from the centralized subscription database according to the primary telephone number and the counter.

6. The method of claim 1, further comprising the steps of provisioning a trigger on the first switch wherein said trigger is provisioned for a line serving the primary telephone number, and wherein step (b) further comprises the steps of receiving the first call at the first switch, and sending a query message from the first switch to a service control point in response to the first call, sending a response message from the service control point to the first switch wherein said response comprises a Forward_Call message and a telephone number for the service node.

7. A method for providing simultaneous ringing on a primary telephone line and a plurality of secondary telephone lines, said method comprising:

(a) populating a database on a service control point with plurality of telephone numbers comprising a primary telephone number and a plurality of secondary telephone numbers;

(b) provisioning on a first switch a trigger for the primary telephone line;

(c) receiving on the first switch a first call to the primary telephone line;

(d) sending a first query from the first switch to the service control point in response to the first call;

(e) checking the status of the primary telephone line and the plurality of secondary telephone lines;

(f) sending a first response message from the service control point to the first switch;

(g) connecting the first call to a service node in response to the first response message;

(h) initiating a second call to the primary telephone line from the service node, wherein said second call has an identification code in a redirecting party field;

(i) receiving on the first switch the second call to the primary telephone line;

(j) sending a second query from the first switch to the service control point in response to the second call;

(k) sending a second response message from the service control point to the first switch wherein said second response provides a first telephone number selected from the plurality of telephone numbers in a called party field;

(l) ringing a first telephone line associated with the first telephone number;

(m) repeating steps (h) through (l) for each telephone number in the plurality of telephone numbers;

(n) connecting the caller if one of the calls is answered; and

(o) disconnecting the service node from each call made in the preceding steps.

8. The method of claim 7, wherein the plurality of subscriber telephone numbers comprises the wireline telephone number and a wireless line telephone number.

9. The method of claim 8, further comprising the steps of setting a first timer before sending the first call setup message and delaying step (i) until the first timer expires.

10. The method of claim 7, further comprising the steps of setting a first timer before sending the first call setup message and delaying step (k) until the first time expires.

11. The method of claim 7, wherein the identification code corresponds to a counter indicating an iteration of step (f).

12. A method for providing simultaneous ringing on a plurality of subscriber telephone lines, said method comprising:

(a) populating a database on a first server with a subscriber's wireline number and a plurality of subscriber telephone numbers;

(b) forwarding to a second server a caller's telephone call when the telephone call is placed to the subscriber's wireline number;

(c) sending a call setup message from the second server to a switch, wherein said call setup message has the wireline number in a called party field and an identification code in a redirecting party field;

(d) querying the database for the wireline number and a telephone number selected from the plurality of subscriber telephone numbers based on the identification code;

(e) inserting the selected telephone number into the called party field;

(f) ringing a customer premises device associated with the selected telephone number;

(g) updating the identification code;

(h) repeating steps (c) through (f) for each telephone number in the plurality of subscriber telephone numbers;

(i) connecting the caller if one of the plurality of subscriber telephone lines is answered; and

(j) disconnecting the second server from each call made in the preceding steps.

13. The method of claim 12, wherein the plurality of subscriber telephone numbers comprises at least one wireless line number.

14. The method of claim 12, further comprising the steps of setting a first timer before sending the call setup message and delaying step (g) until the first timer expires.

15. The method of claim 12, further comprising the steps of setting a first timer before sending the call setup message and delaying step (j) until the first timer expires if none of the plurality of subscriber telephone lines are answered.

16. The method of claim 12, wherein the identification code corresponds to a counter indicating an iteration of step (g).

17. A system providing simultaneous ringing on a plurality of subscriber telephone lines, said system comprising:

(a) a service control point comprising a database including a subscriber's wireline number and a plurality of subscriber telephone numbers;

(b) a first switch in communication with the service control point, wherein the first switch comprises a first trigger on the subscriber's wireline number;

(c) a second switch in communication with the service control point, the first switch and a compact service node, wherein when a call encounters the first trigger, the call is forwarded to the compact service node, and the compact service node sends a first call setup message to the second switch, wherein the first call setup message has the subscriber's wireline number in a called party field and a first identification code in a redirecting party field, and wherein the first call setup message encounters a second trigger on the second switch, wherein the second switch sends a query to the service control point, wherein in response to the query the service control point queries the database for the subscriber's wireline number and selects a telephone number from the plurality of subscriber telephone numbers based on the first identification code, wherein the service control point inserts the selected telephone number into the called party field of a response message and sends the response message to the second switch, wherein the second switch rings a customer premises device associated with the selected telephone number, and wherein the compact service node updates the identification code and repeats sends a second call setup message to the second switch, wherein the second call setup message has the subscriber's wireline number in the called party field and a second identification code in the redirecting party field.

18. The system of claim 17, wherein the plurality of subscriber telephone numbers comprises at least one wireless line number.

19. The system of claim 17, wherein the identification code corresponds to a counter indicating when a call setup message has been sent from the compact service node to the second switch.

20. The system of claim 17, wherein the first switch and the second switch comprise the same switch.

21. The system of claim 17, further comprising a plurality of signaling links connecting the first and second switches and the service control point to a signaling network.

22. The system of claim 21, wherein the signaling network comprises a common channel signaling system number 7 network.

23. The system of claim 17, further comprising a mobile switching center in communication with the service control point and the first and second switches, said mobile switching center logically connected to one of the plurality of subscriber telephone numbers.

* * * * *